Climate change and the impact human-activity has on it

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Overview

Global warming is no longer a concern for everyone living on this planet, but rather a reality that will have an indeterminate impact on humankind. It is a predicament that we cannot afford to ignore or hope that politicians or scientists can solve. It will affect us all and as educators, it is our responsibility to teach students the serious consequences that can result from human activity. Human-induced climate change, Global Warming, is not only a political topic, but a scientific based issue that we need to all share in acknowledging, understanding, and being proactive in resolving. With human fingerprints on greenhouse gases, it is necessary to make a change in society's perspective on what is happening to our Earth's climate and how it can, and will affect us as humans. As technology and understanding of energy develop, so should our abilities to keep our natural environment as stable as we found it. The impact we have on Earth's climate can be controlled from the amount of greenhouse gases we deposit in our atmosphere. By developing new technologies that reduce reliance on fossil fuels, continued conservation methods, and utilization of alternative energy sources.

Rationale

Why teach about global warming to ninth grade biology students? The science of climate change is a topic that is literally, heating up in the scientific community. According to Grant and Littlejohn (2001), there can be little doubt that climate change will be a significant issue, and possibly the central challenge to humankind, during the lifetime of today's students. The topic is complex because the Earth's systems are complex, and scientists themselves are not at all certain of the potential ramifications of our interference with these systems. Equally formidable from an educator's point of view is the intangibility of climate change: its global scale and seemingly slow progression make it a phenomenon that does not easily lend itself to classroom demonstration. The science behind global warming is an essential concept that <u>all</u> high school students should be aware of and ultimately should be able to understand the fundamental principles of the impact it can have on society. This unit on global warming can be

implemented in the Pittsburgh Public Schools biology curriculum. It can be applied in the final unit, unit eight, of the curriculum that deals specifically with environmental issues students face.

Climate change is a complex topic to teach, and a good foundation of conceptual knowledge and facts is required before students can reason about it critically and effectively (McClaren and Hammond, 2001). Moreover, misconceptions abound and are sometimes reinforced by dismally poor media coverage of climate issues and extreme weather events. It is vitally important for curriculum developers and teachers to appreciate the dimensions of climate change as an educational challenge and to approach it responsibly (Sanera and Shaw, 1996). It is clear that teaching about climate change requires multiple approaches that develop students' understanding, reasoning, and critical thinking skills.

Comeau and Mussel (2001) state by the time today's high school graduates retire, the Earth's atmosphere could be loaded with three times more carbon dioxide than it had before the Industrial Revolution. The World Meteorological Organization adds that this will increase the average surface temperatures around the globe from two to six degrees Celsius higher than present averages. They also mention that low-lying islands and coastal populations could be at risk of submersion by rising seas. Extreme weather and climate calamities – droughts, severe storms, forest fires, and floods – could be regular occurrences. These issues in themselves are already happening across the world and students need to understand the significance and relationship this has to global warming.

Global warming undoubtedly sparks the debate of whether increasing concentrations of greenhouse gases in the atmosphere by humans is influencing climate change. Questions then arise that scientists are continually addressing. Questions such as what is causing global warming? Do scientists agree about global warming? What impact will it have on humankind if global warming continues? What is being done about global warming? What can people as individuals do about global warming? These questions are the focus of this curriculum unit designed to address issues surrounding global warming.

The subject of global warming may be something students may be familiar with but not recognize initially the impact it has on the world. The buzzword students may relate to this topic may be the regional and media push for "Going Green" campaign. Students may not understand fully the role climate plays in the way they live. Agricultural productions, how much we use air conditioning or

consume natural gas to heat our homes, and how we obtain our water depends on weather as it relates to climate. Our society's dependence on energy-intensive technology has driven changes in our atmosphere that may lead to not only an unpredictable future in climate, but catastrophic events for future generations.

Ignorance about global warming can be very dangerous. In particular, as humans continue to multiply and occupy more areas of the world, our quality of life may be threatened. Our responsibility as educators is to not only add significant depth to students understanding of issues that affect them, but to bring awareness to them that will help them make informed decisions about our future. Because whether we like or not, the students we teach will some day be running our country.

Objectives

It is important to not bombard students with so much information on global warming that it becomes confusing and intimidating. Leading students to discover impacts of global warming, what they can do to counteract global warming, and tips in being environmentally proactive are the essentials of teaching about human-induced climate change. Objectives that will be covered in this curriculum unit will align with the Pennsylvania Department of Education State Standards. The standards are comprised of two documents: Science and Technology Standards and Environment and Ecology Standards. These documents contain seventeen important categories that describe what students need to know. The purpose of the standards is to articulate essential and assessable elements, and to provide clarity for instruction and for the focus of the state assessment in grades 4, 8, and 11. This curriculum will not cover all seventeen categories, and specific standards will be highlighted in the appendices. The following objectives will to determine what climate scientists views are on global warming, define global warming, the effects of global warming, and what we can do counteract the effects of global warming.

Climate Scientists standpoint on Global Warming

Specifically, Kerry Emanuel (2007), states that human-induced climate change has significantly increased for nearly forty years according to the vast majority of scientists. Karen Arms (2000) acknowledges that many scientists also predict that Earth's average temperature will increase by at least two degrees

Celsius over the next fifty years creating a significant impact across the globe. This concept is known as global warming. In recent decades, scientists have measured and reported record-high average global surface temperatures. Thermometer readings sufficient to provide global averages are available back to 1850 (Brohan et al. 2006).This well-documented warming trend could result from several factors that influence the earth's climate, some of which are natural, such as changes in solar radiation and volcanic activity. Others, particularly the release of certain gases to the atmosphere and land-cover changes, are man made.

Basic Introduction to global warming

"Global warming" refers to the increase of the Earth's average surface temperature, due to a build-up of greenhouse gases in the atmosphere (Pew Center). The greenhouse effect is a natural phenomenon whereby certain gases in the earth's atmosphere, known as greenhouse gases, absorb heat that would otherwise escape to space. This heat originates from visible sunlight that warms the earth's surface. Subsequently, heat radiates from the surface to the atmosphere, where some its absorbed by greenhouse gases and radiated back to the surface (Fig. 3- appendix).

According to the IPPC report in 2001, new evidence and taking into account the remaining uncertainties, most of the observed warming over the last 50 years is likely to have been due to the increase in greenhouse gas concentrations. Le Treut, Somerville, et. al (2007) confirm that Earth's surface is warm because of the presence of greenhouse gases, which act as a partial blanket for the longwave radiation coming from the surface. Le Treut, Somerville, et. al also state that human activities intensify the blanketing effect through the release of greenhouse gases.

Human activities, such as the combustion of fossil fuels and removal of forests have increased the levels of carbon dioxide in the atmosphere by about 35 % in the industrial era. Thus, humankind has dramatically altered the chemical composition of the global atmosphere with substantial implications for climate. Internal combustion engines and manufacturing actions are known sources of carbon dioxide producing human activities. The increase in the strength of the greenhouse effect as a result of man-made greenhouse gases is known as the enhanced greenhouse effect. The reliance humans have on automobiles, technology, and a higher standard of living draw heavily on the burning of fossil fuels. To understand the significance of our dependence on internal combustion

engines, the United States consumes approximately one-quarter of the world's oil production. Thus, we are not only dependent on this energy source; we are contributing massive amounts of greenhouse gases into the atmosphere that is unparallel, particularly in terms of our longevity of consumption.

Effects of global warming

The effects of climate change can be linked to an increase in the intensity and power of hurricanes and flooding, and more rapidly advancing desserts according to Emanuel. Andrea Thompson in March 2008 concludes that a vast ice shelf hanging on by a thin strip looks to be the next chunk to break off from the Antarctic Peninsula, the latest sign of global warming's impact on Earth's southernmost continent. Karen Arms also concludes that Earth's climate has changed dramatically in the past as the great ice ages came and went. However, those changes occurred over hundreds of thousands of years. Scientists are not sure how quickly the Earth will warm or how severe the effects will be. Different computer models give different answers to these questions, which in turn creates controversy which may deduct from experts of climate science credibility.

As a result of a warmer earth, weather patterns, agriculture, and sea levels will be the most documented and noticeable after effects of global warming. As the earth heats up, oceans will absorb more heat energy, which could create more damaging hurricanes and typhoons. Also, scientists are concerned with the change that could occur in ocean current patterns. This change could radically disturb the world's weather. Flooding and droughts could devastate countries that depend on typical weather patterns to drive their economy agriculturally.

Any disruption in weather patterns creates uncertainness among farmers and can spike the prices of crops across the world. In the United States, the Midwest is one of the most profitable and prolific farmlands in the world. A hotter and drier environment would hit farmers hard and could create economical hardship.

Corresponding with economic difficulties that droughts and flooding can have on farmers, the predicaments rising sea levels would have on America would be immeasurable. As polar regions continue to warm, icebergs thaw out causing sea levels to rise. Large coastal cities such as Los Angeles, New York City, Boston, and Miami could not withstand the costs associated with rising sea levels.

What we can do about global warming

The effects of climate change can significantly impact people, our land, and our economy. Global warming is an issue that can turn into a crisis. The formable task of educating not only students, but political leaders is a daunting task involving a concerted effort. These efforts must start with a drastic reduction on our dependence on fossil fuels as a source of energy. This ultimately means we must reduce emissions of greenhouse gases, especially, carbon dioxide.

There are multiple avenues to counteract contributions to global warming. The two most identifiable areas are inside the home and on the road. Insulation, air leaks, hot water heaters, cooking appliances, light bulbs, and other electronic devices are six areas that can be investigated for efficiency and reduction of electricity consumption in the home. Basic ways to reduce consumption of fossil fuels starts in your mode of transportation. Obviously, walking, biking, and public transportation are the most effective ways to reduce dependence on fossil fuels. However, driving a vehicle can be a necessity for people to function in their lives, such as driving to work where public transportation isn't available. Regularly scheduled car maintenance, less aggressive driving, parking, shopping trips, and car-pooling are five areas where more research can be implemented.

Strategies

The objective topics mentioned will be introduced into a first year biology class over a four-week period. These topics were chosen to highlight the basic fundamentals of global warming, how humans are impacting it, and what we can do to reverse its effects. Students will receive a variety of instructional methods. One major method is through lecture notes in students' notebooks on various topics through PowerPoint presentations, overhead projector transparencies, and note-taking guides that students will fill out upon teacher instructions. Note-taking guide offers structured scaffolding for students that are easy to follow. It allows the students to keep track of where note taking occurs and can consolidate information into a more manageable form to comprehend.

Another method is through independent practice on materials provided by the teacher such as worksheets that will engage students individually on assigned topics. Hands-on learning labs are another method of instruction students will do

in lab groups assigned by the teacher. The final method will be through team projects by which students will work on researching specific topics via the Internet, library, and current science articles provided by the teacher.

Classroom Activities

Appendix A: Hands On Activity**:** Gases have No Borders

Concept:

Diffusion is the movement of gas molecules from areas of high concentrations to areas of lower concentration. Greenhouse gases diffuse outward from their sources and become mixed in the atmosphere.

Method:

Put a small amount of a strong smelling (and non-allergenic) substance such as vinegar or peppermint oil onto a cloth or Kleenex. Stand on one side of the classroom and wave the cloth. Ask students to raise their hands as soon as they detect the odor, and time how long it takes everyone to smell it. Discuss the role of diffusion (and wind) in making greenhouse gas emissions a global problem.

Appendix B: Hands on Activity: Gases Like Water

Concepts:

An important property of gases is that they dissolve in water. Dissolved oxygen is essential for the underwater respiration of aquatic organisms, and the ability of carbon dioxide to dissolve in liquid is what enables us to enjoy cold, fizzy beverages on hot summer days. Carbon dioxide is about 200 times more water-soluble than oxygen, and this high solubility means that it easily moves between the atmosphere and bodies of water on Earth' surface.

The world's oceans are referred to as carbon "sinks" and "reservoirs" because they take up huge amounts of carbon dioxide, either directly or through photosynthesis carried out by surface phytoplankton which later decompose on the ocean floor. About half the carbon dioxide emitted by the burning of fossil fuels in the past few decades has been taken up by the oceans and forests.

Purpose:

To demonstrate that there is oxygen dissolved in tap water and that it dissolves more readily in cold water than in warm,

Method:

1. Put equal amounts of cold aerated tap water into two beakers.

2. Place one beaker on a hot plate or over a Bunsen burner at low heat.

3. Observe the bubbles forming on the bottoms and sides of beakers and make comparisons between the warm and cold water. The warmer the water is, the less air that will remain dissolved in it. As a result, air bubbles will form more quickly (come out of solution) in the heated sample.

Appendix C: Alternative Energy Source Research Project

In this lesson, students will explore four alternative energy sources that provide the necessities to maintain a standard of living comparable to the burning of fossil fuels. The first source will be that of geothermal heating and cooling. The second source will be solar energy harvesting. The third source will be the use of nuclear energy. The fourth source will be wind energy. In evaluating and analyzing these alternatives, information on the efficiency, cost effectiveness, and practicality for each of these sources will be compared to that of current fossil fuel energy consumption.

Students will be assigned designated teams not to exceed four students per team. Students then will draw randomly out abovementioned topics to research and present to the class. Students will also be required to present information researched in two formats. One format will consist of a group paper where individual students will be assigned various responsibilities for writing the paper. Students will also have a presentation format in the form of a PowerPoint where each student will be required to present information learned, data, facts, and images pertaining the topic. Students will have access to research materials inside school library, Internet, and various articles provided by teacher. Students will follow formal rubrics consistent with the Pittsburgh Public Schools “Write Tools” requirements.

Appendix D: Warm-up activity/Homework Assignment

The following activity will be used as a prerequisite to the project to assist students in focusing on specific alternative energy sources.

Students will read the article in Newsweek issue: April 14, 2008 "Iceland Has Power to Burn by Daniel Gross- Newsweek" and answer the following questions.

1. What is Iceland's largest tourist destination?
2. When and how was the tourist attraction created?
3. How is electricity created on Iceland?
4. How are most homes heated in Iceland?
5. What are two uses of fossil fuels people are using in Iceland?
6. Iceland began to tap geothermal sources to drive _____ and create electricity.
7. How much electricity usage per capita does Iceland use compared to the United States?
8. What type of emissions does Hellisheidi Geothermal Power Plant produce?
9. How can Iceland contribute to the economic development of foreign countries?
10. How much does gas cost in Iceland at local currency?

Appendix E (Figure 3)

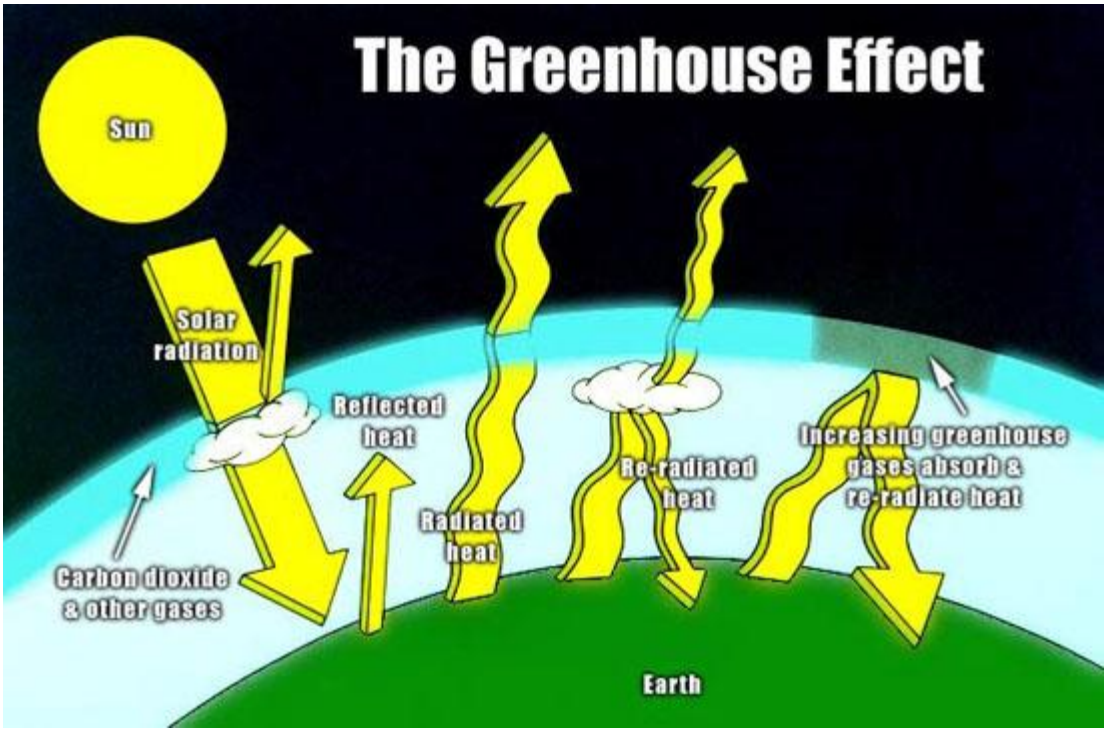

Fig. 3 - The Greenhouse Effect retrieved from: http://www.environment.sa.gov.au/sustainability/images/greenhouse_effect.jpg

Appendix F-Standards

THE ACADEMIC STANDARDS

The following descriptors explain the intent of each standard category:

3.1. Unifying Themes Unifying themes of science and technology provide big ideas that integrate with significant concepts. There are only a few fundamental concepts and processes that form the framework upon which science and technology knowledges are organized - motion and forces, energy, structure of matter, change over time and machines. These themes create the context through which the content of the disciplines can be taught and are emphasized in each standard.

3.2. Inquiry and Design The nature of science and technology is characterized by applying process knowledge that enables students to become independent learners. These skills include observing, classifying, inferring, predicting, measuring, computing, estimating, communicating, using space/time relationships, defining operationally, raising questions, formulating hypotheses, testing and experimenting, designing controlled experiments, recognizing variables, manipulating variables, interpreting data, formulating models, designing models, and producing solutions. Everyone can use them to solve real-life problems. These process skills are developed across the grade levels and differ in the degree of sophistication, quantitative nature and application to the content.

3.7. Technological Devices Students use tools to observe, measure, move and make things. New technological tools and techniques make it possible to enact far-reaching changes in our world. Technology enhances the students' abilities to identify problems and determine solutions. Computers play an integral role in every day life by extending our abilities to collect, analyze and communicate information and ideas.

3.8. Science, Technology and Human Endeavors Scientific knowledge and societal needs often create a demand for new technology. Conversely, new technology advances scientific knowledge. Both influence society through the impact of their products and processes.

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